

REMARKSA. Background

Claims 1-56 were pending in the application at the time of the Office Action. Claims 9-12 were objected to because of indefiniteness. Claims 1-8, 17-20, 48 and 56 were rejected as being anticipated by cited prior art. Claims 29-32, 35-38, 40, 42, 50 and 53 were rejected as being obvious over cited prior art. Claims 9-16, 21-28, 33, 34, 39, 41, 43-47, 49, 51, 52, 54, and 55 were objected to as being dependent upon a rejected base claim. Applicant has herein amended the specification. Applicant has also amended claims 1, 3-12, 17, 29, 35-43, and 47-49; and cancelled claim 2. As such, claims 1 and 3-56 are presented for the Examiner's consideration in light of the following remarks.

B. Proposed Specification Amendments

By this response applicant has amended the paragraph that begins on line 24 of page 3 and the paragraph that begins on line 7 of page 4 of the specification. Specifically, the amendments to these paragraphs change the symbol " $\phi$ " to " $\xi$ " in referring to a phase obtained in the prior art. These amendments have been done to avoid confusion with the use of the symbol " $\phi$ " in later equations in the specification that refer to a different phase. " $\xi$ " is simply used to refer to a phase used in prior art.

Applicant has amended the paragraph that begins on line 25 of page 27 of the specification. The amendments to this paragraph have been done to clarify ambiguous specification language.

Applicant has amended the paragraph that begins on line 18 of page 33 and the paragraph that begins on line 6 of page 43 of the specification. Specifically, the amendments to these paragraphs

change the symbol " $\phi$ " to " $\Psi$ " in referring to a phase. The amendments to these paragraphs have been necessitated due to an error in translation from the original Japanese application.

These amendments are supported by the specification as originally filed. In view of the foregoing, applicant submits that the amendments to the specification do not introduce new matter and entry thereof is respectfully requested.

C. Proposed Claim Amendments

By this response applicant has amended claims 1, 3-12, 17, 29, 35-43, and 47-49; and cancelled claim 2. Claim 1 has been amended to incorporate Claim 2, to clarify that the optical delay line(s) are interposed between the optical multi/demultiplexing device(s), and to clarify that the phase is wavelength dependent. These amendments are supported at least by page 34 and Figures 10 and 13 in the specification as originally filed.

Claims 3 and 4 have been amended to limit the transmission optical frequency band to that of the optical multi/demultiplexing circuit.

Claims 5-8 have been amended to clarify that the optical delay line(s) are interposed between the optical coupler(s), and that the phase is generated by appropriately setting respective coupling ratios of the optical couplers and respective optical path length differences of the optical delay lines. These amendments are supported by at least page 34 of the specification as originally filed.

Claims 9-12 have been amended to clarify that the phase is determined by coupling ratios, that the phase is applied to an optical path length difference, and that a transmission spectrum of the optical multi/demultiplexing circuit is corrected with the phase. These amendments are supported at least by page 34 of the specification as originally filed.

Claims 35-43 have been amended to recite that either a plurality of wave light input into the optical multi/demultiplexing device or a plurality of wave light output from the optical multi/demultiplexing device can alternatively be used. Claims 47-49 have been amended to recite that either the optical delay line device or the optical delay line can include the stated items. Applicant submits that these claim amendments are also supported by the application as originally filed.

In view of the foregoing, applicants submit that the amendments to the claims do not introduce new matter and entry thereof is respectfully requested.

**D. Rejection on the Merits**

The Office Action objected to claims 9-12 because "the reference to symbols ( $\theta$ ,  $\delta$ ,  $\delta L$ ,  $\Psi$ , and  $\Phi$ ) renders the claims indefinite." Accordingly, Applicant has amended claims 9-12 to remedy the objection.

The Office Action rejected claims 1-8, 17-20, 48 and 56 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,882,772 to Lowery et al. In response, Applicant has (i) cancelled claim 2, (ii) amended independent claim 1 to include the limitations of claim 2 and (iii) amended claim 1 to clarify that the phase generated by the phase generating device is wavelength dependent. Claims 3-8, 17-20, 48 and 56 are dependent from claim 1. While not conceding that the Lowery patent anticipates prior claims 1-8, 17-20, 48 and 56, Applicant believes that the amendments made to claim 1 more clearly distinguishes these claims over the Lowery patent.

In the anticipation rejection, the Office Action equates the input port/coupler 6 of Lowery to the phase generating device recited in claim 1 of the current application. However, Lowery only discloses input port/coupler 6 as being a typical coupler; nowhere in Lowery does it disclose that

input port/coupler 6 is a phase generating device. Thus, Lowery is a typical example of the prior art explained in the "Description of the Related Art" section of the current application, and shown in Figure 1. Thus, Applicant respectfully submits that the Lowery patent does not anticipate the invention as claimed in claim 1 because at least one of the elements of the claimed invention is missing from Lowery, *i.e.*, Lowery does not disclose a "phase generating device," as recited in amended claim 1.

Even assuming, *arguendo*, that input port/coupler 6 was a phase generating device, Lowery would still not anticipate the current invention as recited in amended claim 1. In Lowery, arrayed waveguides (12) are fabricated such that optical path lengths increase between adjacent waveguides in the arrayed waveguides (12) as shown in equation (2) (*see* Lowery, col. 3, line 47).

Arrayed waveguides (12) in Lowery are fabricated so that adjacent waveguides have optical path length differences which are given by equation (2), as mentioned above. According to Lowery, the difference  $\Delta L$  between adjacent waveguides for a conventional arrayed waveguide grating (AWG) are constant in prior art. *See* Lowery, col. 2, lines 61-67. But the arrayed waveguides (12) in Lowery have characteristic optical path lengths according to equation (2) (*see* Lowery, col. 3, lines 43-50), and equation (2) seems to introduce quadratic or more changes in phase (*see* Lowery, col. 3 lines 22-23 and 43-45).

It is critical to note that equation (2) of Lowery is a function of the waveguide number. For example, optical path length difference  $\Delta L_{23}$  between the 2<sup>nd</sup> and 3<sup>rd</sup> waveguides and optical path length difference  $\Delta L_{34}$  between the 3<sup>rd</sup> and 4<sup>th</sup> waveguides are characterized by equation (2). In that sense equation (2) is a function of the position or location of the waveguide, thus being spatially dependent.

Thus, the specific optical path length difference  $\Delta L_{23}$  between the 2<sup>nd</sup> and 3<sup>rd</sup> waveguides is constant and not wavelength-dependent. In Lowery, lights with different wavelengths travel along corresponding different waveguides. So wavelength-dependency in Lowery lies in the location of the waveguides, making the waveguides spatially-dependent, not wavelength dependent.

Another point reinforces this. In converting a path length into a corresponding phase (or phase difference or phase shift), the length difference  $\Delta L$  is converted into a corresponding phase  $\xi$  according to the following equation:

$$\xi = \frac{2\pi \cdot n \cdot \Delta L}{\lambda} \quad (a)$$

where  $n$  is the refractive index and  $\lambda$  is the wavelength. See equation (3) on line 10 of page 4 of the current application.

Equation (a) is a definitional equation for converting a path length difference into a phase and vice-versa. The term path length used in the present invention is the length of the waveguide. Therefore, it does not depend on wavelength. Even though  $\lambda$  is used in the denominator, the calculated phase can only be considered wavelength dependent due to the inherent definition of the conversion, and there is no additional wavelength dependent component (element) except for the effect of the definition above. In equation (a),  $n$  is a refractive index, and is not an essential part of this discussion.

According to equation (a), the phase difference between adjacent delay lines (12) in Lowery is calculated by modifying  $\Delta L$  in equation (a) as below:

$$\xi = \frac{2\pi \cdot n \cdot (\Delta L + \delta L)}{\lambda} \quad (b)$$

Contrast this to the present invention. In the present invention, a phase generated by the phase generating device is shown by the additional term  $\Psi(\lambda)$  in equation (c) below.

$$\xi = \frac{2\pi \cdot n \cdot (\Delta L + \delta L)}{\lambda} - \Psi(\lambda) \quad (c)$$

where  $\Psi(\lambda)$  represents a phase dependent on  $\lambda$  applied to the optical delay line. Equation (c) is derived from equation (9) on page 62 of the current application specification and is an expression of a phase component from a complex form (9) which is a transmission characteristic of the optical multi/demultiplexing circuit in the present invention.

The 1st term in equation (c) above  $[ 2\pi n(\Delta L + \delta L)/ \lambda ]$  corresponds to the phase ( $\Delta\theta$ ) converted from a path length difference. See Lowery, col. 3, lines 40-42.  $(\Delta L + \delta L)$  corresponds to equation (2) in Lowery. See Lowery, col. 3, line 47. Thus, a phase is converted, but not generated by Lowery.

On the other hand, the 2nd term of equation (c) above  $[ \Psi(\lambda) ]$  corresponds to a wavelength-dependent phase generated by the phase generating device which is a characteristic portion of the present invention.  $\Psi(\lambda)$  is a function of wavelength  $\lambda$ . Because  $\Psi(\lambda)$  depends on  $\lambda$ , it is **wavelength-dependent**.

The optical path length difference in Lowery corresponds to the 1st term  $(\Delta L + \delta L)$  in equation (b) above. The  $(\Delta L + \delta L)$  is a constant value for any one waveguide and thus not wavelength-dependent. As stated previously the optical path length difference in Lowery is a function of the waveguide's number or space (i.e., the position of the waveguide). The  $(\Delta L + \delta L)$  is characterized according to equation (2) in Lowery.

The following example may help clarify the differences between the current application and Lowery. Assume a light is input into the device depicted in Lowery. The optical path length

difference between the 2<sup>nd</sup> and 3<sup>rd</sup> waveguides ( $\Delta L_{23}$ ) and the optical path length difference between the 3<sup>rd</sup> and 4<sup>th</sup> waveguides ( $\Delta L_{34}$ ) are characterized by equation (2), above.  $\Delta L_{23}$  and  $\Delta L_{34}$  are different from each other, but have constant values which are simply dependent on the position of the specific waveguide. Dependency of the phase is determined by equation (a) above. When the phase shown by equation (b) is reconverted into a path length, the calculated length equals  $\Delta L + \delta L$ , which is what it was before conversion. In other words, the path length is always constant and independent of wavelength.

On the other hand, the path length in the present invention is wavelength dependent because of the contribution from the additional wavelength dependent phase  $\Psi(\lambda)$ . Thus, if the light is input into the current invention as recited in claim 1, a different optical length would be obtained than when first input into the invention because additional wavelength-dependent contributions would be introduced due to  $\Psi(\lambda)$ .

Thus, because the waveguides in Lowery have phase differences which are spatially dependent only and do not vary depending on wavelength, Lowery does not disclose or suggest an optical multi/demultiplexing circuit with a phase generating function that includes a **“phase generating device [that] generates a wavelength-dependent phase,”** as recited in amended claim 1. As a result, Applicant respectfully requests that the anticipation rejection with respect to claim 1 be withdrawn.

Claim 2 has been cancelled, so the rejection with regards to claim 2 is moot. Claims 3-8, 17-20, 48 and 56 depend from claim 1 and thus incorporate the limitations thereof. As such, applicant submits that claims 3-8, 17-20, 48 and 56 are distinguished over the cited art for at least the same reasons as discussed above with regard to claim 1. As a result, Applicant respectfully requests that the anticipation rejection with respect to claims 3-8, 17-20, 48 and 56 also be withdrawn.

The Office Action rejected claims 29-32, 35-38, 40, 42, 50, and 53 under 35 U.S.C. §103(a) as being unpatentable over the Lowery patent, cited above, further in view of various other cited art. None of the various cited art disclose or suggest a phase generating device that generates a wavelength-dependent phase.

Claims 29-32, 35-38, 40, 42, 50, and 53 depend from claim 1 and thus incorporate the limitations thereof. Because none of the various cited art disclose or suggest a phase generating device that generates a wavelength-dependent phase, none of the cited art cure the deficiencies of Lowery, as detailed above. As such, Applicant submits that even assuming, *arguendo*, that it would be obvious to combine the various cited art as asserted by the Office Action, claims 29-32, 35-38, 40, 42, 50, and 53 are distinguished over any cited combination for at least the same reasons as discussed above with regard to claim 1. Thus, Applicant asserts that claims 29-32, 35-38, 40, 42, 50, and 53 are in condition for allowance and respectfully requests that the obviousness rejection with respect to claims 29-32, 35-38, 40, 42, 50, and 53 be withdrawn.

The Office action objected to claims 9-16, 21-28, 33, 34, 39, 41, 43-47, 49, 51, 52, 54, and 55 as being dependent upon a rejected base claim, but asserted that they would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claims 9-16, 21-28, 33, 34, 39, 41, 43-47, 49, 51, 52, 54, and 55 depend from amended claim 1. As discussed above, Applicant asserts that amended claim 1 is now in condition for allowance. Thus, Applicant submits that claims 9-16, 21-28, 33, 34, 39, 41, 43-47, 49, 51, 52, 54, and 55 are no longer dependent on a rejected base claim. As a result, Applicant respectfully requests that the objection with respect to claims 9-16, 21-28, 33, 34, 39, 41, 43-47, 49, 51, 52, 54, and 55 be withdrawn.



## E. Conclusion

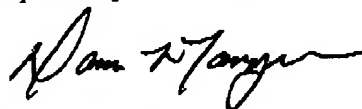
Applicant notes that this response does not discuss every reason why the claims of the present application are distinguished over the cited prior art. Most notably, applicant submits that many if not all of the dependent claims are independently distinguishable over the cited prior art. Applicant has merely submitted those arguments which it considers sufficient to clearly distinguish the claims over the cited prior art.

In view of the foregoing, applicant respectfully requests the Examiner's reconsideration and allowance of claims 1 and 3-56 as amended and presented herein.

In the event there remains any impediment to allowance of the claims which could be clarified in a telephonic interview, the Examiner is respectfully requested to initiate such an interview with the undersigned.

Dated this 13 day of October 2005.

Respectfully submitted,



Dana L. Tangren  
Attorney for Applicant  
Registration No. 37,246  
Customer No. 022913  
Telephone No. 801.533.9800

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